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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/977,375	10/16/2001	Yoshinobu Ono	2185-0578P	3053
2292	7590 07/18/2002			
BIRCH STI	EWART KOLASCH &	EXAMINER		
PO BOX 747 FALLS CHURCH, VA 22040-0747			IM, JUNGHWA M	
			ART UNIT	PAPER NUMBER
			2811	
		•	DATE MAIL ED: 07/18/2003	,

Please find below and/or attached an Office communication concerning this application or proceeding.

				<u> </u>
•		Application No.	Applicant(s)	
Office Action Summary		09/977,375	ONO ET AL.	
		Examiner	Art Unit	
	The MAIL ING DATE And	Junghwa M. Im	2811	
P riod fo	• •		•	
THE II - Exter after - If the - If NO - Failui - Any r	ORTENED STATUTORY PERIOD FOR REPLY MAILING DATE OF THIS COMMUNICATION. Issions of time may be available under the provisions of 37 CFR 1.1 SIX (6) MONTHS from the mailing date of this communication. Period for reply specified above is less than thirty (30) days, a reply period for reply is specified above, the maximum statutory period we to reply within the set or extended period for reply will, by statute eply received by the Office later than three months after the mailing of patent term adjustment. See 37 CFR 1.704(b).	36(a). In no event, however, may a reply be till y within the statutory minimum of thirty (30) day will apply and will expire SIX (6) MONTHS from CAUSE the application to become ABANDONE.	mely filed ys will be considered timely. the mailing date of this communication.	
1)🖂	Responsive to communication(s) filed on 20 J	lune 2002 .		
2a)	This action is FINAL . 2b)⊠ Th	is action is non-final.		
3) 🗌 Dispositi	Since this application is in condition for allowa closed in accordance with the practice under on of Claims	ance except for formal matters, p Ex parte Quayle, 1935 C.D. 11, 4	rosecution as to the merits is 453 O.G. 213.	i
4)⊠	Claim(s) 1-13 is/are pending in the application			
4	4a) Of the above claim(s) <u>12, 13</u> is/are withdray	vn from consideration.		
5)	Claim(s) is/are allowed.			
6)⊠	Claim(s) <u>1-11</u> is/are rejected.	•		
7)	Claim(s) is/are objected to.			
	Claim(s) are subject to restriction and/or on Papers	election requirement.		
	· The specification is objected to by the Examiner	·.		
	he drawing(s) filed on is/are: a)□ accep		miner.	
	Applicant may not request that any objection to the	•		
11)□ T	he proposed drawing correction filed on	-	` '	
	If approved, corrected drawings are required in rep	ly to this Office action.		
12)∐ T	he oath or declaration is objected to by the Exa	aminer.		
Priority u	nder 35 U.S.C. §§ 119 and 120			
13)🛛 .	Acknowledgment is made of a claim for foreign	priority under 35 U.S.C. § 119(a)-(d) or (f).	
a)[∑	☑ All b) ☐ Some * c) ☐ None of:			
•	1. Certified copies of the priority documents	have been received.		
2	2. Certified copies of the priority documents	have been received in Application	on No	
	3. Copies of the certified copies of the priori application from the International Bur	eau (PCT Rule 17.2(a)).		
	ee the attached detailed Office action for a list of	•		
	cknowledgment is made of a claim for domestic. The translation of the foreign language pro-			۱).
15)∐ A	The translation of the foreign language proveknowledgment is made of a claim for domestice.			
Attachment(·			
2) Notice	of References Cited (PTO-892) of Draftsperson's Patent Drawing Review (PTO-948) ation Disclosure Statement(s) (PTO-1449) Paper No(s) <u>6</u> .		(PTO-413) Paper No(s) Patent Application (PTO-152)	
S. Patent and Trac PTO-326 (Rev.		ion Summary	Part of Paper No. 9	



Application/Control Number: 09/977,375

Art Unit: 2811

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of claims 1-11 in Paper No. 9 is acknowledged.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 11 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 11 recites a fragment of a sentence and does not carry an explicit meaning.

Claim Rejections - 35 USC § 103

- 3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:
 - (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.
- 4. Claims 1-3, 6, and 7 are rejected under 35 U.S.C. 103 (a) as being unpatentable



over Mishima et al. (U.S. Pat. No. 5,633,516) in view of Inoue (U.S. Pat. No.5,134,446) and Kizuki (U.S. Pat. No. 5,948,161).

Regarding claim1, Mishima et al. show, in Fig.1, a 3-5 group compound semiconductor comprising

a GaAs substrate (1), a buffer layer (2) on said GaAs substrate and an epitaxial crystal layer (5) on said buffer layer, and said layers being formed by an epitaxial crystal growth method, wherein said buffer layer and said epitaxial crystal layer on said buffer layer are 3-5 group compound semiconductors each independently represented by the general formula $In_xGa_yAl_zAs$ (wherein, $0 \le x \le 1$, $0 \le y \le 1$, $0 \le z \le 1$, x + y + z = 1) (col.3, lines 26-52 and col.4, lines 28-34).

Mishima et al. do not explicitly show that the dislocation density in the epitaxial crystal layer on the buffer layer is 2000/cm² or less.

Inoue teaches that a semiconductor device of GaAs substrate with a buffer structure having the dislocation density of the crystal layers (13, 15 in Fig.2) with the limitation of the claimed invention as recited above (col. 5, lines 8-18).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teaching of Inoue into the device taught by Mishima et al. since the device breakdown can be alleviated through the reduction of the defect density and resulting lattice-misfit.

Kizuki also motivates a defect density of less than 2000/cm² at column 11, lines 2-12.

Application/Control Number: 09/977,375

Art Unit: 2811

Such a defect density would have been obvious in order to have a high quality device layer as taught by Kizuki.

Regarding claim 2, Mishima et al. disclose most aspects of the claimed invention as discussed in claim1.

Mishima et al. do not show that the dislocation density in the epitaxial crystal layer on the buffer layer is 1/3 or less of the dislocation density in said GaAs substrate.

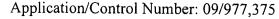
Inoue, however, shows that the dislocation density of the crystal layer on the buffer layer is 1/3 or less of the dislocation density of the substrate through following example.

In col.1, lines 44-48, Inoue discloses the GaAs substrate with a dislocation density of 10¹² /cm². And Inoue discloses, in col. 5, lines 8-18, the dislocation density of the crystal layer on the buffer layer can be reduced to about 1x 106/cm².

Regarding claim 3, Mishima et al. disclose that the 3-5 group compound semiconductor the said buffer layer has a structure formed by laminating at least two kinds of layers having different compositions, for n ($1 \le n \le 30$) times (col.3, lines 26-52, col.4, lines 28-34).

Regarding claim 6, Mishima et al. show that at least one layer of two kinds of layers in the buffer layer is doped with an n-type dopant (col. 5, line 22 and col.4, lines 28-34).

Regarding claim 7, Mishima et al. show that said n-type dopant is Si and the concentration of the Si is 1×10^{17} cm⁻³ or less (col.5, lines 43-45).



5. Claims 4, 5 and 8-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mishima et al. and Inoue as applied to claims 1-3 above, and further in view of Schmitz et al. (U.S. Pat. No. 6,316,820).

Regarding claim 4, Mishima et al. and Inoue do not disclose that two kind of layers in the buffer layer are a $Ga_{1-z}Al_zAs$ layer (wherein, $0 < z \le 1$) and a GaAs layer.

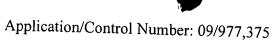
Schmitz et al. show that a device with a buffer layer (26) in Fig.1 made of AlGaAs/GaAs.

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teaching of Schmitz et al. into the device taught by Mishima et al. and Inoue since the heterojunction structure of the buffer layer absorbs the dislocation gradually and improves the performance of the device.

Regarding claim 5, Inoue teaches that the value of z in one of the buffer layers $(Ga_{1-z}Al_zAs \text{ layer})$ can be 0.1 or more and 0.4 or less. Although the buffer layer of Inoue is made of $Ga_{1-z}In_zAs$, it is also taught that In can be replaced with other group III elements, such as B or Al (Col.7, lines 20-23). Further, Inoue discloses that the composition of the In content is not limited and can be smaller or larger (col.6, line 55 – col.7, line 6).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to choose relative composition of the element as recited in the claim, in order to achieve maximum absorption of the distortion cause as a result of the lattice mismatch.

Regarding claims 8 –10, Mishima et al. show that the buffer layer is doped with n



type Si dopant as discussed above.

Schmitz et al. disclose that Si planar dopant layer on the upper portion of the buffer layer which is recited in the instant claim as "on the interface of at least one layer of two kinds of layers " (col.5, lines 61-65).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teaching of Schmitz et al. into the device taught by Mishima et al. and Inoue since propagation of the distortion toward the upper layer is suppressed through uniform doping on a specific plane in a buffer layer, resulting in improved reliability of the device.

Regarding the planar doping concentration, Mishima et al. teach the concentration of Si in terms of volume as discussed above, while the instant claim recites the identical concentration range in term of surface area.

Conclusion

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Junghwa M. Im whose telephone number is (703) 305-3998. The examiner can normally be reached on MON.-FRI. 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (703) 308-2772. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

JMI July 12, 2002

> Sara Crane Primary Examiner